

From Survey Plans to Land Cover Maps:

Data Generalization in the Cartographic materials of the General Land Survey in Russia (1765-1800)

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Abstract

The article reviews the massive set of low-scale maps, covering the major part of European Russia, composed in the late XVIII century by the Survey department. Methods of field surveys, map making, and cartographic generalization are considered.

Keywords: General Land Survey, cartography, XVIII century, Russia

The General Land Survey is one of the key events in the history of Russian cartography. One of the most ambitious projects of Catherine II, it was launched by the manifest of 1765. Its mission was not only to consider the land property rights, but also to create the all-Russia land cadaster, a thorough investigation of the country's demographic, economic and natural resources, and, last but not least, to provide the imperial administration with a set of high-scale maps of the country. The work, coordinated by the Survey department of the Senate, continued for more than a century, and was never fully completed. The impressive amount of work was done in the late XVIII century, however. By 1800, the Survey was finished in 19 provinces (*gubernii*) of European part of Russian empire (German, 1914) (see figure 1). This vast territory included over 1,5 million square kilometers and over 70 % of the empire's total population.

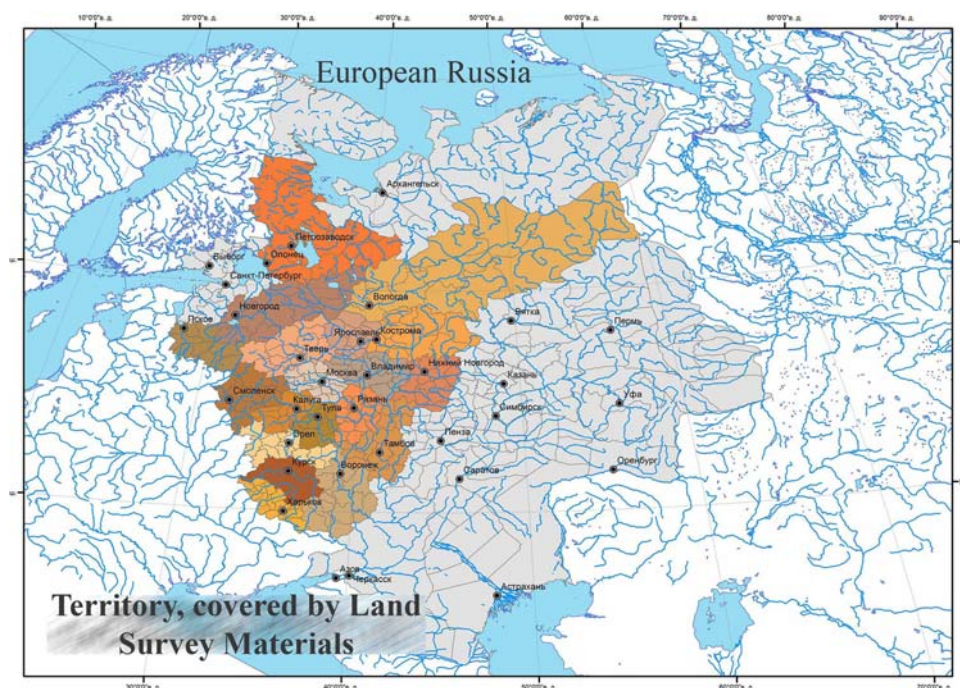


Figure 1. Territory, covered by the General Land Survey in 1765 - 1796

After the decades of intensive work, an impressive set of documents was created. For now, the Survey Archive in Russian State Archive of Ancient Documents, Moscow, stores over 1,3 million archival units, being the largest documental complex of pre-revolutionary Russia (Milov 1965). Over 600 000 of them are maps. Regarding the scale (1:8400 for the primary maps), the territory covered, and the amount of field work done, the General Land Survey is one of the world's largest cartographic projects of the XVIII century.

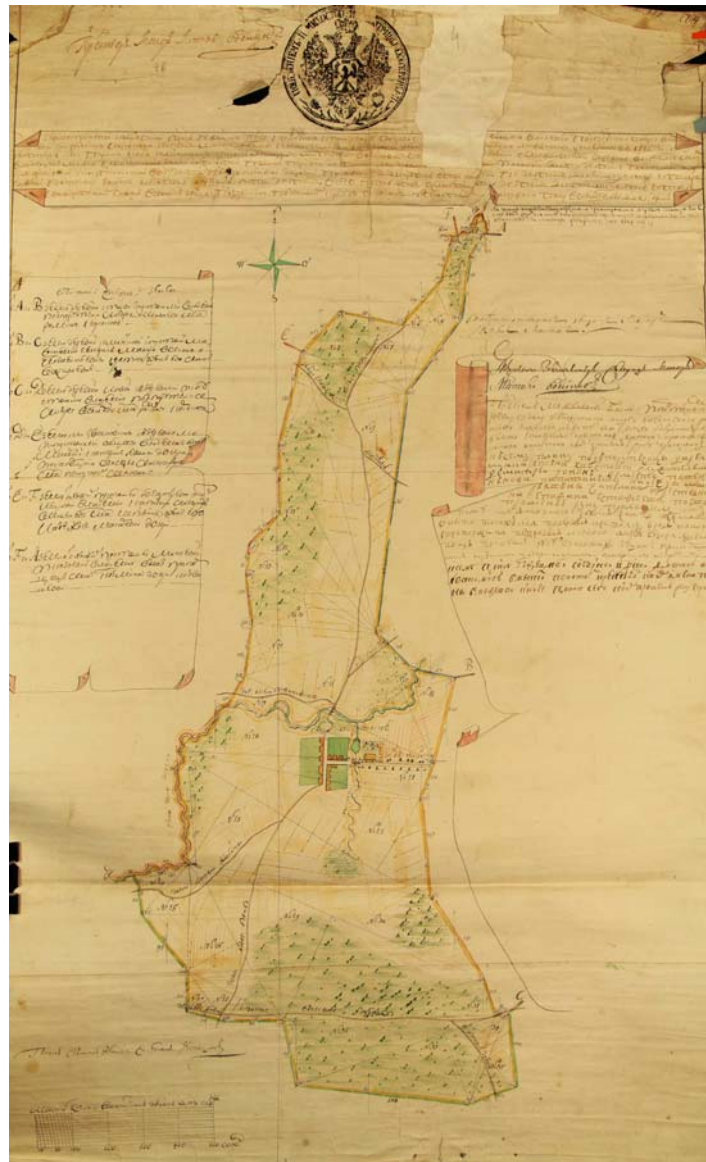


Figure 2. Dacha plan (village Andreevskoje). RSAAD. F. 1354. Inventory 494. F. A4 «sinee»

Being the earliest and most detailed maps of imperial Russia, these materials are widely used by the researchers. The archaeologists and historians of medieval Russia use them as a code of toponimics, invaluable for localizing certain locations, mentioned in the earlier sources (Frolov & Piotukh 2008). Also, the numerous works on the history of population, settlement, and colonization use those data (Khitrov et al. 2011), as well as the local historians, working on the history of a particular district or even settlement. But the data on the land cover and land use, which were of primary importance for the surveyors themselves, are, for now, generally underestimated. The historians, geographers, and soil scientists, working on these materials together, can create the source-based reconstruction of land cover for that period, revealing the socio-economic and natural factors of land use change (Gedymin 1998, Shoba & Alyabina 2006).

In this article, we'll try to evaluate the quality and reliability of the data on land use, provided by the primary and aggregated materials of the General Land Survey.

The extensive survey works were conducted by several survey offices; each of them was responsible for several *gubernias*. After the major amount of work was finished, the field parties moved to the next *gubenia*, where the survey was 'opened'. The party included a surveyor (a retired army or fleet officer, lieutenant or captain, as a rule), a deputy surveyor, 12 soldiers, and numerous workers, recruited among the local peasants. Also, the representatives of the engaged landlords and peasant communities were involved, called *poverennye* ('attorneys'), and their verification was the assurance of the accuracy of measurements. Normally, 10 to 20 parties worked in each *uezd* (administrative district), and their number increased if the territory was large or landowning was fractional.

For the late XVIII century, the methods the surveyors used were a bit obsolete (Fel' 1960, Kusov 1993, 2003, Postnikov 1996). Due to the lack of geodetic instruments and qualified staff, the Survey Department chose not to use map projections and geographic coordinates; generally, the methods the surveyors used dated back to the medieval Russian 'land-measuring', not to the European cartography of the Modern era; a significant influence of the French survey technics should be mentioned, however.

The Survey party enveloped the boundaries of the manors, one after another. Each time the border changed its direction, the surveyor recorded the angle of rotation, and the direction to the North, using the astrolabe and compass; the lengths were measured using chains and ropes. The work was held under the thorough control of the neighboring peasants and nobles, and the newly established border was marked by the pits, filled with coal, and specially marked trees and stones.

The primary (and the most important) survey map was the plan of the landowning, *dacha*. Being an official certificate of landownership, it was composed soon after the measurements were completed. Theoretically, the full set of angles and lengths, recorded in the field, used to be just put on the paper, registering all the figures and all the boundary marks. This was rarely the case, however. As a rule, the starting and the finishing points of the polygon didn't match, due to the inaccuracies in the measurements and underestimation of relief.

The work in each *uezd* started with the survey of the city boundaries. This work tended to be exemplary, as the most competent staff was involved, and numerous city dwellers observed the process. The duration of bypass was brief (in XVIII century the cities, even with pastures, were quite small), and all the participants stayed in maximum concentration. But in the rural area, the situation could be different.

Especially the large forests and rivers presented a significant difficulty. In the large Northern *gubernias* like Vologda and Novgorod, with the vast forest massives and low population density, the surveyors often did not inspect the distant and uninhabited territories. In such *dachas*, a significant amount of plans retained only a cartouche, i.e. the upper part containing stamp, the name of settlement, the name of the surveyor, and the natural and economic characteristics of the territory. Others were made, but later declared ineligible, and were destroyed. The banks of the large rivers were often covered by thick vegetation or waterlogged, so surveyors measured the distance from strictly defined line and water every 10 meters and represented the coast line quite sketchy.

Within the *dacha* polygon, the general picture of land use was shown. Using a developed system of symbols, the deputy surveyor marked fields, hayfields, muds, swamps, bushes, and also places, roads, rivers, ponds, relief objects and circumstances of land tenure, etc. In most cases, no evidence of his

activity has been preserved, but in some rare plans *dachas* we find the lines marking his path (see figure 3). Of course, the inner parts of the *dacha* were not measured in the way the boundary was. But the size of fields and hays was verified by the local peasants, and the vast practical experience of the surveyors was a guarantee that the map didn't get too far from reality.



Figure 3. *Dacha* plan from Kasimov uezd. RSAAD. F. 1354. Inventory 404. F. D33 "krasnoe".

When the set of *dacha* plans for a particular *uezd* was complete, surveyors moved to creating the plan of the whole *uezd* scale of 1 versta per inch (1:21000). *Uezd* was depicted on the plan as a whole, which made them extremely large and barely suitable for usage. This is the reason why not all of them survived. This was the first stage of data systematization after surveying the relevant province (for the provinces of European Russia, the late 1770's - early 1790's). If the province borders changed, they were remade; for instance, in Nizhny Novgorod we have such plans for Balakhna, Nizhny Novgorod, Semenovsk *uezds*. Due to the extreme inconvenience of working with them, a strong exposure to physical damage, the impossibility of a partial correction another type of *uezd* plan was invented, in scale of 2 versta per inch (scale 1:42000). This type of plan contains summary data on the boundaries' frontiers, configuration and width of the largest rivers, the roads, and the statistical data on economy and land use - the configuration of arable land, forests, grasslands and wetlands. Although the level of detalization was similar with that of 1 versta plan, some differences should be mentioned: 1) reduction or absence of information on the boundary disputes; 2) often boundary stamp was absent, with a *gubernia* or *uezd* coat of arms presented instead. Typically, these plans took a form of atlas (up to 15 - 17 parts, especially in provinces with low population density, like Vologda, Novgorod and Perm province).



Figure 4. Plan of Balakhna uezd. Scale of 2 versta per inch (1:42000). RSAAD. F. 1356. Inventory 1. F. 2606

Actually, these documents were not very important from the point of view of land cadaster, as it was the *dacha* plan that was used to confirm the land property rights. Sometimes they could be used as the directories to find the number of the particular *dacha*, but generally, the administrative and even scientific tasks were of much greater importance.

For the modern researchers, the *uezd* plans seem to be the most interesting documents of the Survey, however. They cover the vast territories, and contain the abundant information on settlement, land use, etc. On the other hand, they are not so overwhelmingly numerous, as the *dacha* plans (over 600000 archival units), and the existing collection (6800 plans) does not contain significant lacunas. They cover the major part of the inner *gubernias* of Russia, with the exception of some Northern Territories.

The problem is that the methods of compiling these maps remain unclear. Of course, they were very different from the modern methods of cartographic generalization. But does this mean that they are not reliable?

The surveyors started from the city, and tried to combine the *dacha* plans into the whole picture, as if they were some kind of a puzzle. Of course, they didn't match each other absolutely; so, some extortion was inevitable. The calculations made for Balakhna, Borovsk and Krasnoborsk *uezds*, showed that the surveyors tended to extort the angles, but not the distances.



Figure 5. Representation of the city of Balakhna on the uezd plan (on the left side, RSAAD. F. 1356. Inventory 1. F. 2604) and on dacha plan (RSAAD. F. 1354. Inventory 263. F. C66 "krasnoe")

The problem became much more difficult as the surveyors approached the *uezd* border. If the nearby used was already surveyed, they had to put on the map the border which matched its boundary; if not, they could choose to wait until their colleagues will finish their work. In this case, the completion of the plan could be delayed for years.

Also, significant differences between the *uezd* plans and even the separate parts of a single plan existed. Detalization, precision, scrupulousness, and even the manner of presentation could differ much, especially. Obviously, this can be due to the qualification of a particular cartographer, but also to some other factors. For instance, all the parts of the Balakhna *uezd* plan are signed by the "provincial secretary Stepan Venechansky", and yet the difference is clearly visible.

The northern part of the Balakhna *uezd*, which is its most densely populated and agriculturally developed area, is mapped more accurately, with the good detalization, and even 'artistically'. The map of land use (see figure 6) shows us, that fields dominated in this area. Also, a lane of arable land existed near the left bank of Volga, and a narrow strip extends along the southern border. For all those lands

the plan presents the excellent detalization and precision. On the contrary, the forest areas are presented quite roughly. An assumption can be made about the correlation between the population density, the level of agricultural development, and the quality of *uezd* plans.

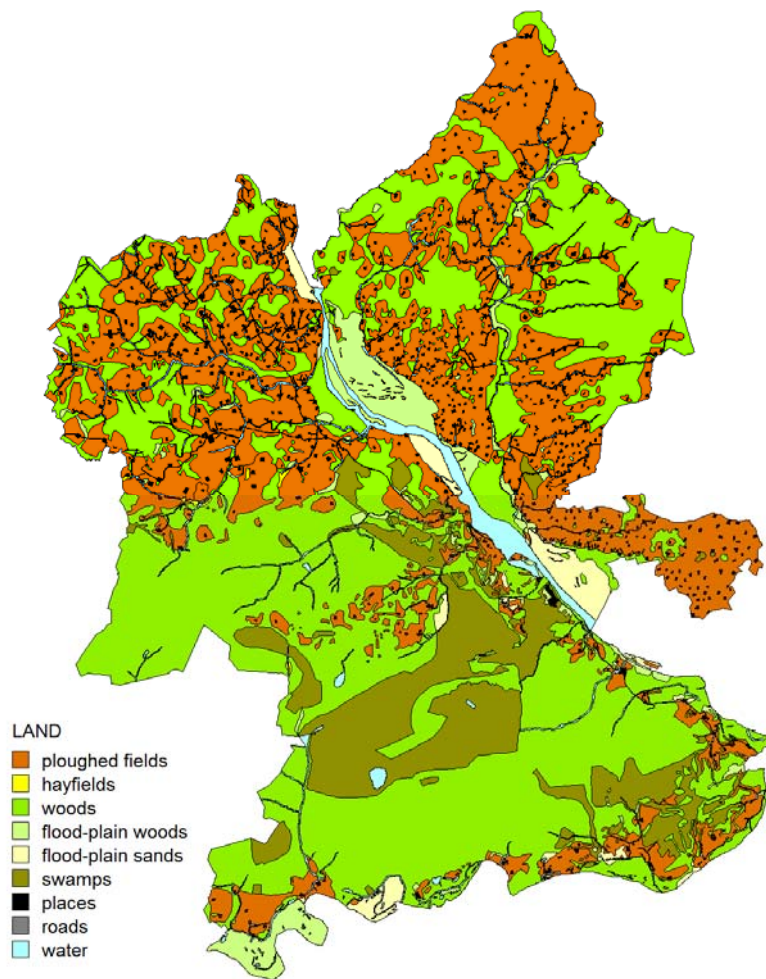


Figure 6. Map of land tenure in Balakhna uezd.

So, although the methods the surveyors used to create the *uezd* plans have little to do with modern cartography, a clear algorithm exists, which makes them not just the schemes, but maps of a special kind. But are they suitable for computer mapping? Perhaps it is possible to bring some theory to what was a purely practical question. For each part of the *uezd* plan, the distortion was minimum in the center, accumulating towards its borders. At the same time, a kind of 'rigid frame' existed, as the surveyors tended to deform angles, but not to change lengths. So, binding the plan requires the numerous control points, put at the key points of the boundaries structure (but not within the dachas, as the inner parts of the plots were mapped with much less accuracy). Once it is done, the *uezd* plan matches the modern map no worse than any map of the XVIII or even XIX century. Thus, it appears that the plans of the General Land Survey prepared by consecutive map transformation can be used to study with the methods of GIS analysis in conjunction with other cartographic materials.

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